

IN THE SPECIFICATION:

Please amend the specification as follows:

Please substitute the paragraph beginning at page 1, line 6, with the following.

-- The present invention relates to an exposure apparatus for transferring a pattern on a mask ~~to~~ onto a photosensitive substrate via a projection optical system. Such an exposure apparatus is used in lithography in manufacturing, e.g., a semiconductor element. --

Please substitute the paragraph beginning at page 2, line 8, with the following.

-- In this situation, demands are arising from measuring imaging performance, e.g., aberration, particularly, wavefront aberration of the projection optical system while the projection optical system is mounted in the exposure apparatus, i.e., is actually used for exposure. This is because measurement of aberration enables more precise lens adjustment corresponding to the state and device design almost free from the influence of aberration. --

Please substitute the paragraph beginning at page 3, line 11, and ending on page 4, line 4, with the following.

-- As a method of obtaining wavefront aberration, an interferometer is used. However, the interferometer is generally used as an inspection device in the manufacture of a projection optical system, and is not practically mounted in the exposure apparatus in terms of the technique and cost because an interferometer made up of a prism, mirror, lens, and the like, and an interference illumination system having good coherence must be arranged near a reticle stage or

wafer stage in the method using the interferometer. In general, the space near the wafer stage or reticle stage is limited, and the sizes of the interferometer and illumination system must, therefore, be limited. Limitations are also imposed in terms of heat generating and vibration, and the interferometer is difficult to mount. With recent decreases in exposure wavelength, an interferometer light source having good coherence in the exposure wavelength region does not exist or is very expensive. Thus, it is not practical in terms of the technique and cost to mount an interferometer type aberration measurement device in a projection exposure apparatus. --

Please substitute the paragraph beginning at page 23, line 21, and ending on page 25, line 2, with the following.

-- In still another aspect of the present invention, the foregoing object is attained by providing a transfer method of transferring a pattern to a substrate by using a projection exposure apparatus, the projection exposure apparatus having an illumination system, a projection optical system for projecting a pattern on a substrate, a holding portion for holding a first mask having a first transmission portion between the illumination system and the projection optical system, a second mask which is arranged near an object plane of the projection optical system and has a second transmission portion, and a reflecting mirror arranged on an image plane side of the projection optical system, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, and passes through the projection optical system again being incident on the second transmission portion, the method comprising: the measurement step of measuring an intensity of light which

is emitted by the illumination system, is reflected by the reflection mirror, passes through the projection optical system again, and passes through the second transmission portion while the second mask is driven along the object plane of the projection optical system; the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step; the adjustment step of adjusting the projection optical system on the basis of aberration obtained in the arithmetic step; and the transfer step of transferring a pattern to the substrate by using the projection exposure apparatus in which the projection optical system is adjusted. --

Please substitute the paragraph beginning at page 30, line 2, and ending on page 31, line 12, with the following.

-- In still another aspect of the present invention, the foregoing is attained by providing a method of manufacturing a device by using a projection exposure apparatus, the projection exposure apparatus having an illumination system, a projection optical system for projecting a pattern on a substrate, a holding portion for holding a first mask having a first transmission portion between the illumination system and the projection optical system, a second mask which is arranged near an object plane of the projection optical system and has a second transmission portion, and a reflecting mirror arranged on an image plane side of the projection optical system, light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, and passes through the projection optical system, again being incident on the second transmission portion, the method

comprising: the measurement step of measuring an intensity of light which is emitted by the illumination system, passes through the first transmission portion and the projection optical system, is reflected by the reflecting mirror, passes through the projection optical system again, and passes through the second transmission portion while the second mask is driven along the object plane of the projection optical system; the arithmetic step of calculating aberration of the projection optical system on the basis of a measurement result obtained in the measurement step; the adjustment step of adjusting the projection optical system on the basis of the aberration obtained in the arithmetic step; the transfer step of transferring a pattern to a photosensitive member of the substrate coated with the photosensitive member by using the projection exposure apparatus in which the projection optical system is adjusted; and the developing step of developing the photosensitive member bearing the pattern. --

Please substitute the paragraph beginning at page 34, line 11, with the following.

-- Fig. 9 is a partial, enlarged view showing the second transmission portion T and light intensity distribution measurement device; --

Please substitute the paragraph beginning at page 35, line 23, with the following.

-- Fig. 23, is a partial, enlarged view showing the second transmission portion and light intensity distribution measurement device; --

Please substitute the paragraph beginning at page 36, line 2, with the following.

-- Fig. 25 is a partial, enlarged view showing the transmission portion and light intensity distribution measurement device; --

Please substitute the paragraph beginning at page 36, line 17, with the following.

-- Fig. 29 is a schematic view showing a projection exposure apparatus according to the ~~10th~~ tenth embodiment of the present invention; --

Please substitute the paragraph beginning at page 36, line 25, and ending on page 37, line 3, with the following.

-- The principle of the present invention will be explained. The present invention is based on the principle adopted in, e.g., the Foucault test, wire test, phase modulation test, and Ronchi test (see, e.g., Daniel Malacara, "Optical Shop testing", John Wiley & Sons, Inc., page 231 (1978)). --

Please substitute the paragraph beginning at page 37, line 8, with the following.

-- Fig. 1 shows the state of a beam near the imaging point. In Fig. 1, a ray  $A_1$  which is emitted by an illumination system (not shown), passes through a first transmission portion (optical element) regarded as a point object formed on a first mask (not shown), ~~and~~ passes through a projection optical system (not shown) and deviates from an ideal imaging performance IP. A second mask 17M having a second transmission portion 17G, and a light intensity

distribution measurement device 18 for measuring the light intensity distribution of a beam having passed through the transmission portion 17T are arranged near the imaging point. --

Please substitute the paragraph beginning at page 39, line 11, with the following.

--¶ For this reason, changes in light intensity at respective points on the light intensity distribution measurement device 18 are plotted while the position (u, v) or the second transmission port 17T is moved. As a result, a distribution shifted in phase by an amount corresponding to ray aberration (changes in intensity along with movement) can be obtained. This phase shift amount can be obtained to determine ray aberration. --

Please substitute the paragraph beginning at page 40, line 16, and ending on page 41, line 6, with the following.

-- In the above description, the first transmission portion (optical element) arranged between the illumination system and the projection optical system is regarded as a point object. If the first transmission portion is an object smaller than the isoplanatic region of the projection optical system, the transmission portion need not be so small as to be regarded as a point object. In the isoplanatic region, aberration is regarded to be equal throughout this region. Imaging beams with the same aberration that pass through respective points of the first transmission portion are superimposed into the image of the first transmission portion. The plot obtained by scanning the image of the first transmission portion at the second transmission portion 17T has a

distribution obtained by superimposing, by size of the second pattern image, the plots in which the first transmission portion is regarded as the point object. --

Please substitute the paragraph beginning at page 41, line 7, with the following.

-- Fig. 5 shows a beam near the imaging point of the projection optical system when the first transmission portion arranged between the illumination system and the projection optical system is a square aperture in the isoplanatic region.  $A'$  represents a beam corresponding to the ray  $A$ ; and  $P'$ , a beam corresponding to the principal ray  $P$ . The sections of the two beams are squares equal in size because of the isoplanatic region, and the beam  $A'$  deviates from the beam  $P'$  by the aberration  $(\epsilon, \eta)$  of the ray  $A$ . Let  $I'_0(u, v)$  be the light intensity of a portion corresponding to the beam  $P'$  when the position of the second transmission portion 17T is  $(u, v)$ , and  $I'_a(u, v)$  be the light intensity of a portion corresponding to the beam  $A'$ . Then, as is apparent from Figs. 6A and 6B, we have

$$I'_a(u, v) = I'_0(u - \epsilon, v - \eta), \text{ --}$$

Please substitute the paragraph beginning at page 42, line 24, and ending on page 43, line 3, with the following.

-- Letting  $R'$  be as the optical length between the position where the imaging beam crosses the reference sphere and the position where the imaging beam crosses the imaging plane, wavefront aberration  $\phi$  and the ray aberration  $(\epsilon, \eta)$  satisfy

$$\varepsilon(x, y) = R' \frac{\partial \phi}{\partial x} \quad \dots (1)$$

$$\eta(x, y) = R' \frac{\partial \phi}{\partial y} \quad \dots (2) \text{ --}$$

Please substitute the paragraph beginning at page 44, line 15, and ending on page 45, line 20, with the following.

-- In this embodiment, an illumination system 16 serves as both an illumination system for a circuit pattern (mask pattern) and an illumination system for the first transmission portion 11 serving as a measurement pattern. A beam emitted by the illumination system 16 passes through the mask 12, which is arranged near the object plane (object-side focal position) of the projection optical system 10 and has the first transmission portion 11. The beam forms the image of the first transmission portion 11 at the image-side focal position of the projection optical system 10 via the projection optical system 10. The beam passes through the second transmission portion 17T arranged near the imaging position of the image of the first transmission portion 11, and reaches the measurement surface of the light intensity distribution measurement device 18 where the light intensity distribution is measured. The mask 17M having the second transmission portion 17T and the light intensity distribution measurement device 18 are mounted on a wafer stage 14. The mask 17M is aligned near the imaging position of the image of the first transmission portion 11. A controller 19 controls an actuator (31 in Fig. 9) to scan the mask 17M (second transmission portion 17T) in a plane (image plane) perpendicular to



an optical axis AX of the projection optical system 10. A signal processor 20 processes a signal of the light intensity distribution (change along with scan) measured by the light intensity distribution measurement device 18, and obtains aberration such as wavefront aberration of the projection optical system 10. The wafer stage 14 supports a wafer chuck 13 and is driven by a driving device 15. --

Please substitute the paragraph beginning at page 46, line 16, and ending on page 47, line 21, with the following.

-- Fig. 9 is a partial, enlarged view showing the second transmission portion 17T and light intensity distribution measurement device 18. The second transmission portion 17T and light intensity distribution measurement device 18 are aligned by the wafer stage 14, which holds them, so as to locate the second transmission portion 17T near the imaging position of the image of the first transmission portion 11. A position on the light intensity measurement surface (light-receiving surface) of the light intensity distribution measurement device 18 is in one-to-one correspondence with a position on the exit pupil of the projection optical system. This can be realized by separating the light intensity measurement surface of the light intensity distribution measurement device 18 from the imaging position of the projection optical system toward the optical axis AX by a certain distance. This can also be realized by using a pupil imaging optical system for imaging the exit pupil of the projection optical system 10 onto the light intensity measurement surface of the light intensity distribution measurement device 18. The object-side focal position of the pupil imaging optical system coincides with the position of the second

transmission portion 17T, and its image-side focal position coincides with the light intensity measurement surface. The light intensity distribution measurement device 18 has, e.g., a solid-state image sensing element on which many pixels are two-dimensionally arrayed. The image sensing region of the solid-state image sensing element is determined to satisfactorily cover the pupil of the projection optical system 10. --

Please substitute the paragraph beginning at page 47, line 22, and ending on page 48, line 12, with the following.

-- In this state, the second transmission portion 17T is scanned by an actuator 31 in a plane perpendicular to the optical axis AX. The signal processor 20 detects, as a light intensity distribution, changes in light intensity at the respective light-receiving units (pixels) of the solid-state image sensing element of the light intensity distribution measurement device 18 with respect to the position (u, v) of the second transmission portion 17T. As a result, ray aberration ( $\epsilon(x, y)$ ,  $\eta(x, y)$ ) can be obtained. Note that (x, y) is represents positional coordinates on the measurement surface of the light intensity distribution measurement device 18, and is in one-to-one correspondence with coordinates on the exit pupil of the projection optical system 10. The signal processor 20 calculates wavefront aberration  $\phi(x, y)$  from the obtained ray aberration on the basis of equations (1) and (2) described above. --

Please substitute the paragraph beginning at page 50, line 5, with the following.

-- Q<sub>3</sub>: point at which a straight line Q<sub>2</sub>Q<sub>2</sub> crosses the intensity distribution measurement surface D, i.e., the point at which the imaging beam from the first transmission portion 11 crosses the intensity distribution measurement surface D when no aberration exists --

Please substitute the paragraph beginning at page 51, line 18, with the following.

-- From the above-mentioned relationship between wavefront aberration and ray aberration, we have

$$\varepsilon = R' \frac{\partial \phi}{\partial X} = R \left( 1 + \frac{\Delta R}{R} \right) \frac{\partial \phi}{\partial X}$$

$$\eta = R' \frac{\partial \phi}{\partial Y} = R \left( 1 + \frac{\Delta R}{R} \right) \frac{\partial \phi}{\partial Y}$$

where  $\Delta R = R' - R$

$$\alpha = L' \frac{\partial \phi}{\partial X} = L \left( 1 + \frac{\Delta L}{L} \right) \frac{\partial \phi}{\partial X}$$

$$\beta = L' \frac{\partial \phi}{\partial Y} = L \left( 1 + \frac{\Delta L}{L} \right) \frac{\partial \phi}{\partial Y}$$

where  $\Delta L = L' - L$  --

Please substitute the paragraph beginning at page 52, line 20, with the following.

-- Letting Q<sub>3</sub> (X', Y') be the point at which the beam crosses the intensity distribution measurement surface D when the beam emerges without any aberration from the point Q<sub>2</sub> (X',

$Y')$ , at which the imaging beam from the first transmission portion 11 crosses the reference sphere plane, equations (9) and (10) in Fig. 16 hold from the relationship with the normalized coordinates in Fig. 10. --

Please substitute the paragraph beginning at page 54, line 9, and ending on page 55, line 17, with the following.

-- The second embodiment of the present invention will be explained with reference to Fig. 11. The second embodiment relates to a projection exposure apparatus in which a first transmission portion 11 is arranged on the imaging plane of a circuit pattern (transfer pattern) 12P of a reticle 12, the first transmission portion 11 is illuminated under predetermined illumination conditions, and a second transmission portion 17T is arranged near the imaging position of the image of the first transmission portion that is formed on the reticle 12 via a projection optical system 10. The first transmission portion 11 is set on a wafer stage 14 and illuminated by a second illumination system 21 mounted on the wafer stage 14. The second illumination system 21 as a light source can use light guided from a first illumination system 16 via a guide system 22 such as a fiber light guide. The first transmission portion 11 and second illumination system 21 are moved by the wafer stage 14 so as to locate the first transmission portion 11 at a position on the imaging plane of the transfer pattern 12P, i.e., a position where aberration is measured. A beam from the first transmission portion 11 is formed by the projection optical system 10 into an image on the reticle 12 side of the projection optical system 10. The imaging beam is deflected by a mirror 23. A mask 17M having the second transmission

portion 17T is arranged near the imaging position formed by the deflected beam. The mask 17M is scanned by an actuator controlled by a controller 19 along a surface conjugate to the object plane (plane where the mask pattern 12P is set) of the projection optical system 10. The remaining same reference numerals as those in Fig. 7 denote the same parts. --

Please substitute the paragraph beginning at page 56, line 12, and ending on page 57, line 5, with the following.

-- In the third embodiment, the illumination system for illuminating the transfer pattern 12P also serves as an illumination system for illuminating the reflecting member 110. The illumination system illuminates the reflecting member 110 via a mask 12 having a transmission portion at a portion conjugate to the reflecting member 110, a semitransparent mirror 24, and the projection optical system 10. In this case, the mask 12 may be eliminated. The beam scattered and reflected by the reflecting member 110 is formed by the projection optical system 10 into an image on the reticle side of the projection optical system 10. The imaging beam is reflected by the semitransparent mirror 24 to deflect the optical path. A transmission portion 17T is arranged near the imaging position formed by the deflected beam. A mask 17M is scanned by an actuator controlled by a controller 19 along a surface conjugate to the object plane (plane where the mask pattern 12P is set) of the projection optical system 10. The remaining same reference numerals as those in Fig. 7 denote the same parts. --

Please substitute the paragraph beginning at page 57, line 19, and ending on page 58, line 8, with the following.

-- The second illumination system 25 illuminates the reflecting member 110 via a mask 12 having a transmission portion at a portion conjugate to the reflecting member 110, a semitransparent mirror 24, and the projection optical system 10. In this case, the mask 12 may be eliminated. The beam scattered and reflected by the reflecting member 110 is formed by the projection optical system 10 into an image on the mask side of the projection optical system 10. The imaging beam is deflected by the semitransparent mirror 24. A mask 17M is arranged near the imaging position formed by the deflected beam. The mask 17M is scanned by an actuator controlled by a controller 19 along a surface conjugate to the object plane (plane where the mask pattern 12P is set) of the projection optical system 10. The remaining same reference numerals as those in Fig. 7 denote the same parts. --

Please substitute the paragraph beginning at page 58, line 9, with the following.

-- In the projection exposure apparatuses of the first to fourth embodiments described above, a plurality of lenses among a plurality of optical elements, which constitute the projection optical system 10, are movable in the optical axis direction and/or a direction perpendicular to the optical axis. One or a plurality of aberrations (particularly, Seidel's five aberrations) in the optical system 10 can be corrected or optimized by moving one or a plurality of lenses by an aberration adjustment driving system (not shown) on the basis of wavefront aberration information obtained by using the above-mentioned methods and apparatuses. A means for

adjusting the aberration of the projection optical system 10 includes not only a movable lens but also various known systems such as a movable mirror (when the optical system is a catadioptric system), a tiltable plane-parallel plate, and a pressure-controllable space. --

Please substitute the paragraph beginning at page 59, line 1, with the following.

-- Fig. 18 is a view showing a projection exposure apparatus according to the fifth embodiment of the present invention. A beam emitted by an illumination system 16 passes through a mask 12 having a first transmission portion (optical element) 11, and forms the image of the first transmission portion 11 at the image-side focal position of a projection optical system 10 via this system ~~16~~ 16. The beam passes through a second transmission portion 17T arranged near the imaging position of the first transmission portion 11, and reaches the measurement surface of a light intensity distribution measurement device 18 where the light intensity distribution is measured. A second mask 17M having the second transmission portion 17T and the light intensity distribution measurement device 18 are mounted on a wafer stage 14 and aligned near the imaging position of the first transmission portion 11. A controller 19 controls an actuator 31 to scan the mask 17M in a plane perpendicular to an optical axis AX of the projection optical system 10. A signal processor 20 processes a signal of the light intensity distribution (change along with scan) measured by the light intensity distribution measurement device 18, and obtains the wavefront aberration of the projection optical system 10. --

Please substitute the paragraph beginning at page 61, line 1, with the following.

-- Fig. 9 is a partial, enlarged view showing the second transmission portion 17T and light intensity distribution measurement device 18. The second transmission portion 17T and light intensity distribution measurement device 18 are aligned by the wafer stage 14 so as to locate the second transmission portion 17T near the imaging position of the first transmission portion 11 (image-side focal position of the projection optical system 10). --

Please substitute the paragraph beginning at page 62, line 5, with the following.

-- In this state, the second transmission portion 17T is scanned by the actuator 31 in a plane perpendicular to the optical axis AX. The signal processor 20 receives changes in light intensity detected by the respective pixels of the solid-state image sensing element of the light intensity distribution measurement device 18 with respect to the position (u, v) of the second transmission portion 17T. As a result, ray aberration ( $\varepsilon(x, y)$ ,  $\eta(x, y)$ ) is obtained. Note that (x, y) is represents positional coordinates on the measurement surface of the light intensity distribution measurement device 18, and is in one-to-one correspondence with coordinates on the exit pupil of the projection optical system 10. The signal processor 20 calculates wavefront aberration  $\phi(x, y)$  from the obtained ray aberration on the basis of equations (1) and (2) described above. --

Please substitute the paragraph beginning at page 62, line 23, and ending on page 63, line 1, with the following.



-- Fig. 19 is a view showing a projection exposure apparatus according to the sixth embodiment of the present invention ~~that~~ which comprises first and second transmission portions and a light intensity distribution measurement device for measuring the imaging performance of a projection optical system. --

Please substitute the paragraph beginning at page 68, line 13, with the following.

-- Fig. 23 is a partial, enlarged view showing the second transmission portion 115 and light intensity distribution measurement device 116. --

Please substitute the paragraph beginning at page 69, line 15, and ending on page 70, line 6, with the following.

-- The second transmission portion 115 scans a plane perpendicular to the optical axis P by the actuator 115C. The light intensity distribution signal processor 116A performs a signal processing based on the above-mentioned principle for changes in light intensity at the respective light-receiving units (pixels) of the light intensity distribution measurement device 116 with respect to the position of the transmission portion 115. Accordingly, ray aberration ( $\epsilon(x, y)$ ,  $\eta(x, y)$ ) can be obtained. Note that  $(x, y)$  ~~is~~ represents positional coordinates on the light intensity measurement surface D of the light intensity distribution measurement device 116, and ~~is also~~ coordinates on the exit pupil plane of the projection optical system 114. The signal processor 116A calculates wavefront aberration  $\phi(x, y)$ , from the obtained ray aberration by:

$$\epsilon(x, y) = R' \cdot (\partial \phi / \partial x) \quad \dots (1)$$

$$\eta(x, y) = R' \cdot (\partial \phi / \partial y) \quad \dots (2) \text{ --}$$

Please substitute the paragraph beginning at page 71, line 8, with the following.

-- The mask 225A has the second transmission portion 225 such as an aperture slit. The second transmission portion 225 is movable by an actuator 225C along the z and y directions perpendicular to the optical axis P of the projection optical system 224 ~~that~~ , which is deflected by the deflection optical system 228. The actuator 225 C is controlled by an actuator controller 225D, and the moving amount of the actuator 225C is transferred as data to a signal processor 226A. --

Please substitute the paragraph beginning at page 72, line 23, with the following.

-- Fig. 25 is a partial, enlarged view showing the second transmission portion 225 and light intensity distribution measurement device 226. --

Please substitute the paragraph beginning at page 75, line 18, and ending on page 76, line 6, with the following.

-- For example, the reduction magnification of the projection optical system 224 is 5x. Letting E be the transverse aberration amount measured in the seventh embodiment and  $\epsilon$  be the transverse aberration amount measured in the eighth embodiment, from equations (1) and (17) their ratio is:

$$\epsilon/E = 2 \cdot (NA_i/NA_0) = 10 \quad \dots (19)$$

In the eighth embodiment, a transverse aberration amount ~~10~~ ten times that in the seventh embodiment is observed, and the measurement precision of the wavefront aberration  $\phi$  greatly increases. Note that  $NA_i$  is the numerical aperture of the projection optical system 224 on the wafer side, and calculation of equation (19) exploits the reduction magnification of the projection optical system 224:

$$(NA_i/NA_0) = 5, \text{ --}$$

Please substitute the paragraph beginning at page 76, line 26, and ending on page 77, line 9, with the following.

-- The reflection optical system 339 uses a spherical mirror identical to that of the eighth embodiment. The center of curvature of the spherical mirror is decentered in a direction perpendicular to an optical axis P near the imaging position of the first transmission portion 331. The image of the first transmission portion 331, which is reflected by the reflection optical system 339 and passes through the projection optical system 334, again is formed at a position deviated from the first transmission portion 331 in a direction perpendicular to the optical axis P. --

Please substitute the paragraph beginning at page 77, line 10, with the following.

-- As shown in Fig. 28, which is an enlarged view of the main part in Fig. 27, the light intensity distribution measurement device 336 comprises a reflecting mirror 336D in addition to

a pupil imaging optical system 336B and solid-state image sensing element 336C. The solid-state image sensing element 336C is conjugate to the entrance pupil of the projection optical system 334 via the pupil imaging optical system 336B. --

Please substitute the paragraph beginning at page 77, line 19, with the following.

-- Also, in the ninth embodiment, the second mask having the second transmission port 335 such as a slit at an ideal imaging position Po is scanned, and the light intensity distribution measurement device 336 measures the light intensity distribution. The ninth embodiment is smaller in light quantity loss than the eighth embodiment because of the absence of the semitransparent optical axis deflection optical system 228. --

Please substitute the paragraph beginning at page 78, line 1, with the following.

-- [~~10th~~ Tenth Embodiment] --

Please substitute the paragraph beginning at page 78, line 2, with the following.

-- The ~~10th~~ tenth embodiment of the present invention will be described with reference to Fig. 29. --

Please substitute the paragraph beginning at page 78, line 4, with the following.

-- In the ~~10th~~ tenth embodiment, shown in Fig. 29, a projection exposure apparatus 400 comprises a mask 441 having a first transmission portion, a mask 441A, an auxiliary illumination

system 443, a projection optical system 444, a mask 445 having a second transmission portion (scan pattern), a light intensity distribution measurement device 446, a wafer stage 447, a reflection optical system 449, a guide optical system 440A, and a light output system 440B for outputting a beam propagating through the guide optical system 440A. --

Please substitute the paragraph beginning at page 78, line 14, with the following.

-- In the ~~10th~~ tenth embodiment, the first mask 441 having the first transmission portion such as a circular aperture and the second mask 445 having the second transmission portion are arranged on the wafer stage 447. The reflection optical system 449 has the center of curvature near the mask 441A and is decentered from the optical axis of the projection optical system 444. --

Please substitute the paragraph beginning at page 79, line 3, with the following.

-- According to the ~~10th~~ tenth embodiment, a beam which passes through the transmission portion of the mask 441 and the projection optical system 444 is reflected by the reflection optical system 449. The light which is reflected by the reflection optical system 449 and passes through the projection optical system 444 again forms an image in a plane which is perpendicular to the optical axis of the projection optical system 444 and coincides with the mask 441 having the transmission portion. The imaging beam scans the mask 445 having the second transmission portion, and the light intensity distribution is measured by the light intensity distribution measurement device 446. A signal processor 446A processes the position of the

second transmission portion of the second mask 445 and the light intensity distribution, thereby measuring the aberration of the projection optical system 444. --

Please substitute the paragraph beginning at page 79, line 24, and ending on page 80, line 14, with the following.

-- Fig. 30 is a flow chart for explaining the manufacture of a semiconductor device (e.g., a semiconductor chip such as an IC or LSI, a liquid crystal panel, a CCD, or the like). In step 1 (circuit design), a semiconductor device circuit is designed. In step 2 (mask formation), a mask having the designed circuit pattern is formed. In step 3 (wafer manufacture), a wafer is manufactured by using a material such as silicon. In step 4 (wafer process) called a pre-process, an actual circuit is formed on the wafer by lithography using a prepared mask and the wafer. Step 5 (assembly), called a post-process, is the step of forming a semiconductor chip by using the wafer formed in step 4, and includes an assembly process (dicing and bonding) and a packaging process (chip encapsulation). In step 6 (inspection), inspections such as the operation confirmation test and durability test of the semiconductor device manufactured in step 5 are conducted. After these steps, the semiconductor device is completed and shipped (step 7). --

Please substitute the paragraph beginning at page 81, line 6, with the following.

-- The manufacturing method of this embodiment can manufacture a high-precision semiconductor device, which is difficult to manufacture by a conventional method. --

Please substitute the paragraph beginning at page 81, line 9, with the following.

-- As has been described above, the present invention realizes measurement of the wavefront aberration of a projection optical system in a state in which the projection optical system can be actually used for exposure. The present invention enables more precise adjustment of the projection optical system and the design of a device, which is hardly influenced by aberration. --